

# BFG92A/X

NPN 5 GHz wideband transistor

Rev. 06 — 12 March 2008

Product data sheet

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NXP Semiconductors

# NPN 5 GHz wideband transistor

# BFG92A/X

### FEATURES

- High power gain
- Low noise figure
- Gold metallization ensures excellent reliability.

### APPLICATIONS

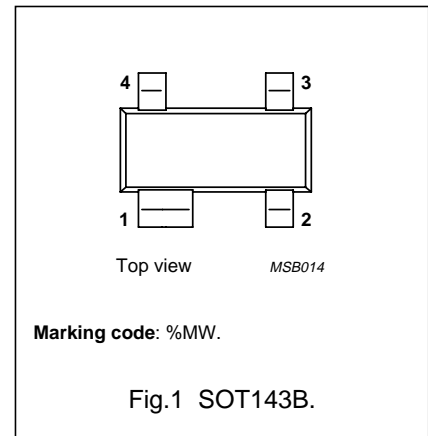
Wideband applications in the UHF and microwave range.

### DESCRIPTION

Silicon NPN transistor in a 4-pin, dual-emitter SOT143B plastic package.

### PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | collector   |
| 2   | emitter     |
| 3   | base        |
| 4   | emitter     |



### QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                     | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------|--|------|------|------|------|
| $V_{CBO}$ | collector-base voltage        |  | –    | –    | 20   | V    |
| $V_{CEO}$ | collector-emitter voltage     |  | –    | –    | 15   | V    |
| $I_C$     | collector current (DC)        |  | –    | –    | 25   | mA   |
| $P_{tot}$ | total power dissipation       | $T_s \leq 60\text{ }^\circ\text{C}$  | –    | –    | 400  | mW   |
| $C_{re}$  | feedback capacitance          | $I_C = i_c = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$  | –    | 0.35 | –    | pF   |
| $f_T$     | transition frequency          | $I_C = 15\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$   | 3.5  | 5    | –    | GHz  |
| $G_{UM}$  | maximum unilateral power gain | $I_C = 15\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ ; $f = 1\text{ GHz}$                            | –    | 16   | –    | dB   |
|           |                               | $I_C = 15\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ ; $f = 2\text{ GHz}$                            | –    | 11   | –    | dB   |
| F         | noise figure                  | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ ; $f = 1\text{ GHz}$ | –    | 2    | –    | dB   |

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**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL           | PARAMETER                 | CONDITIONS                     | MIN. | MAX. | UNIT |
|------------------|---------------------------|--------------------------------|------|------|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter                   | –    | 20   | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                      | –    | 15   | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                 | –    | 2    | V    |
| I <sub>C</sub>   | collector current (DC)    |                                | –    | 25   | mA   |
| P <sub>tot</sub> | total power dissipation   | T <sub>s</sub> ≤ 60 °C; note 1 | –    | 400  | mW   |
| T <sub>stg</sub> | storage temperature range |                                | –65  | 150  | °C   |
| T <sub>j</sub>   | junction temperature      |                                | –    | 175  | °C   |

**Note**

1. T<sub>s</sub> is the temperature at the soldering point of the collector pin.

**THERMAL CHARACTERISTICS**

| SYMBOL              | PARAMETER   | CONDITIONS | VALUE | UNIT |
|---------------------|---|------------|-------|------|
| R <sub>th j-s</sub> | thermal resistance from junction to soldering point | note 1     | 290   | K/W  |

**Note**

1. T<sub>s</sub> is the temperature at the soldering point of the collector pin.

**CHARACTERISTICS**

T<sub>j</sub> = 25 °C unless otherwise specified.

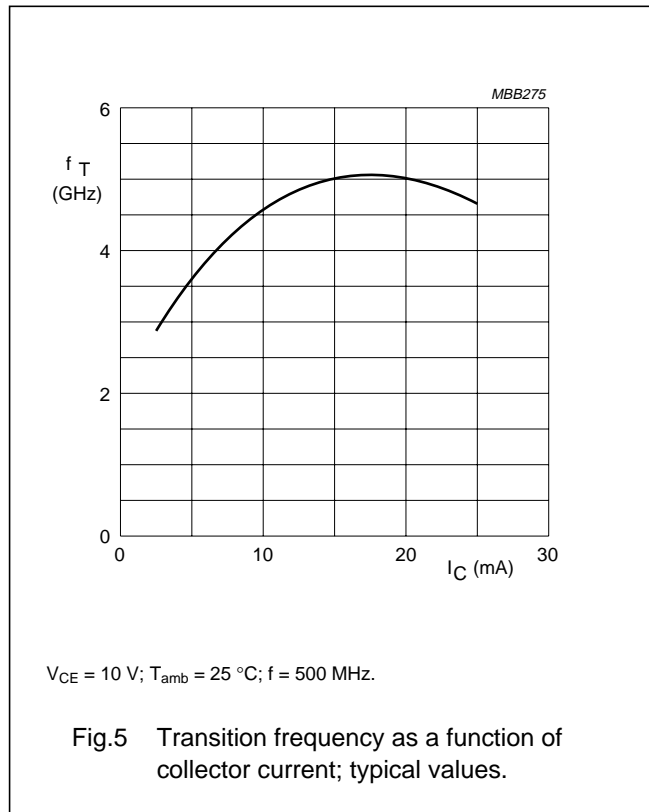
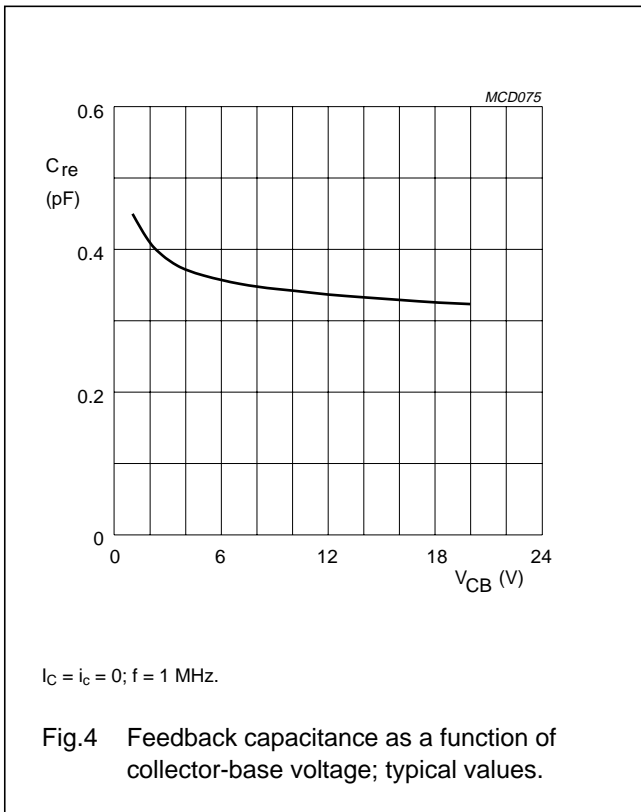
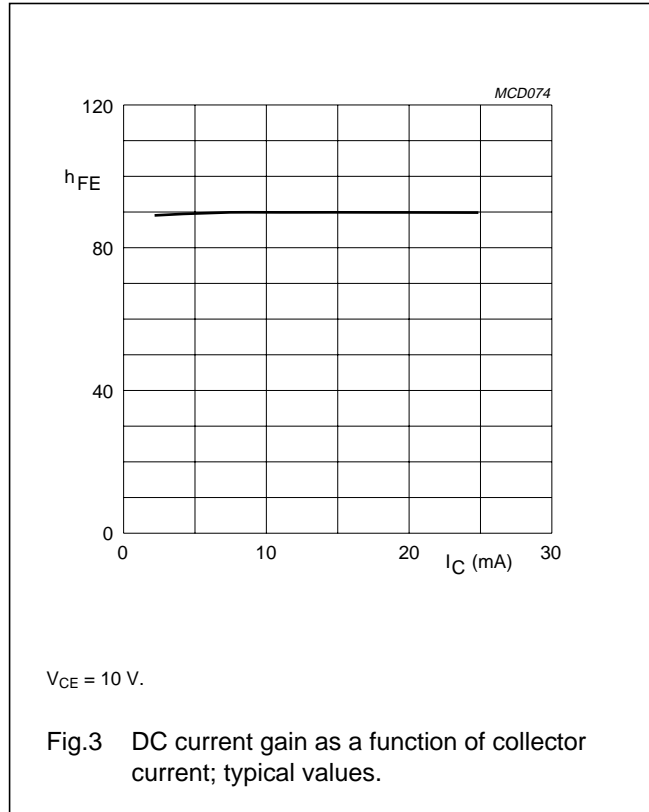
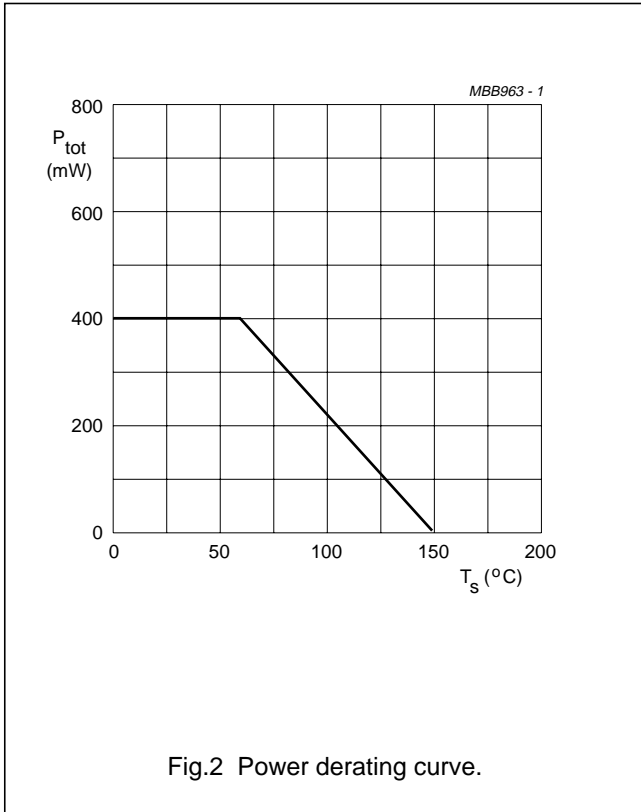
| SYMBOL           | PARAMETER                             | CONDITIONS  | MIN. | TYP. | MAX. | UNIT |
|------------------|---------------------------------------|---|------|------|------|------|
| I <sub>CBO</sub> | collector leakage current             | I <sub>E</sub> = 0; V <sub>CB</sub> = 10 V  | –    | –    | 50   | nA   |
| h <sub>FE</sub>  | DC current gain                       | I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 10 V  | 65   | 90   | 135  |      |
| C <sub>c</sub>   | collector capacitance                 | I <sub>E</sub> = i <sub>e</sub> = 0; V <sub>CB</sub> = 10 V; f = 1 MHz  | –    | 0.6  | –    | pF   |
| C <sub>e</sub>   | emitter capacitance                   | I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>EB</sub> = 10 V; f = 1 MHz  | –    | 0.9  | –    | pF   |
| C <sub>re</sub>  | feedback capacitance                  | I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>CB</sub> = 10 V; f = 1 MHz  | –    | 0.35 | –    | pF   |
| f <sub>T</sub>   | transition frequency                  | I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 10 V; f = 500 MHz   | 3.5  | 5    | –    | GHz  |
| G <sub>UM</sub>  | maximum unilateral power gain; note 1 | I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 10 V;<br>T <sub>amb</sub> = 25 °C; f = 1 GHz                                    | –    | 16   | –    | dB   |
|                  |                                       | I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 10 V;<br>T <sub>amb</sub> = 25 °C; f = 2 GHz                                    | –    | 11   | –    | dB   |
| F                | noise figure                          | Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 10 V;<br>T <sub>amb</sub> = 25 °C; f = 1 GHz | –    | 2    | –    | dB   |
|                  |                                       | Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 10 V;<br>T <sub>amb</sub> = 25 °C; f = 2 GHz | –    | 3    | –    | dB   |

**Note**

1. G<sub>UM</sub> is the maximum unilateral power gain, assuming S<sub>12</sub> is zero and  $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$  dB.

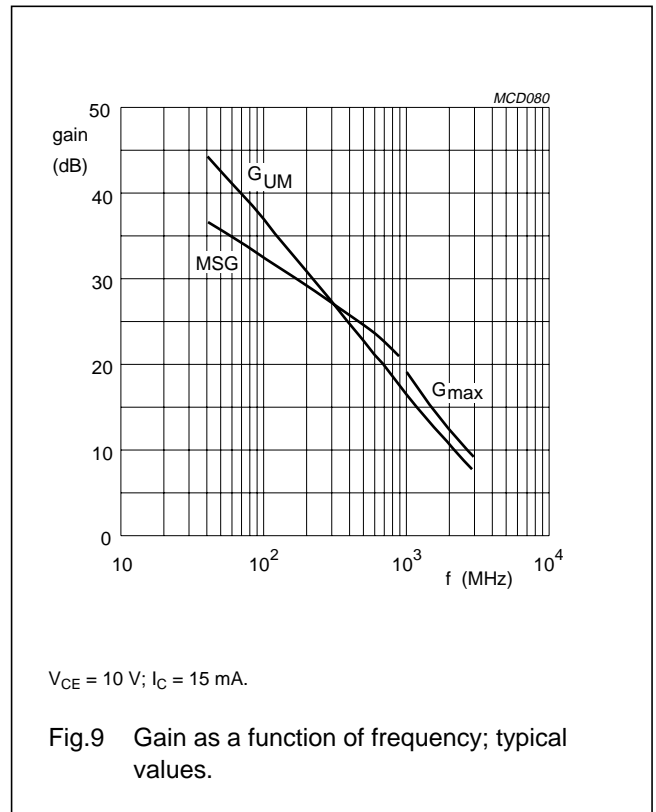
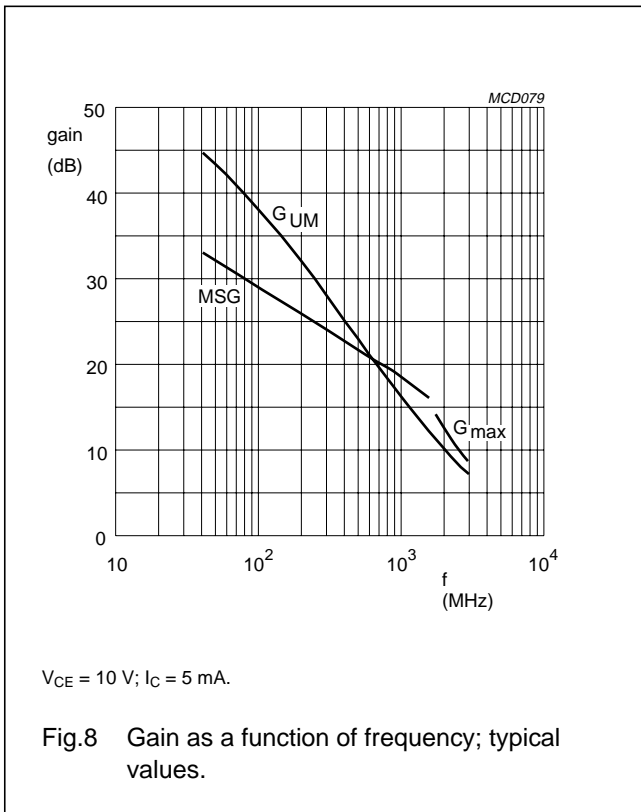
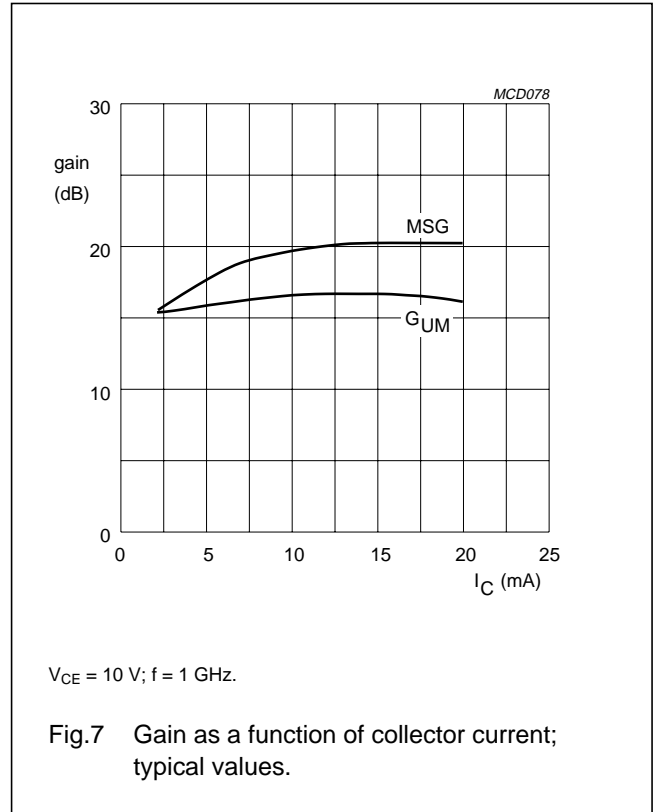
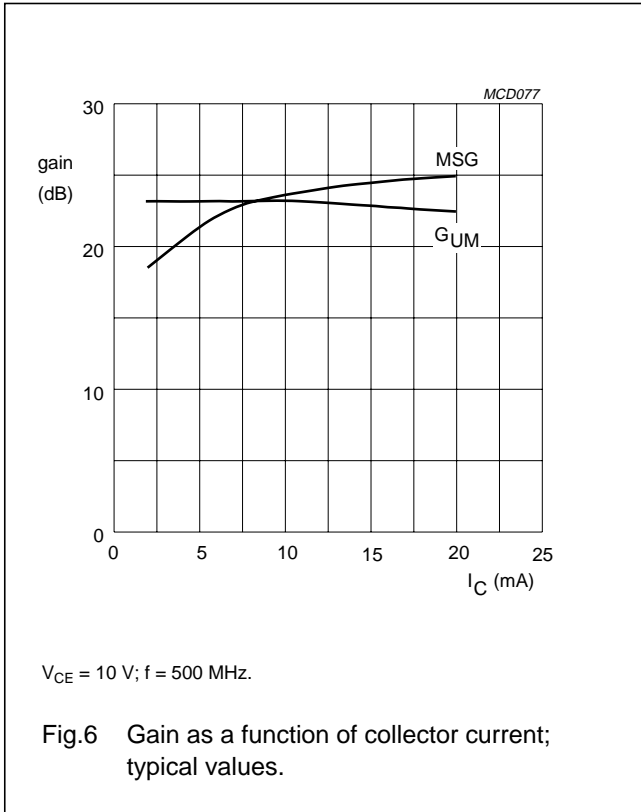
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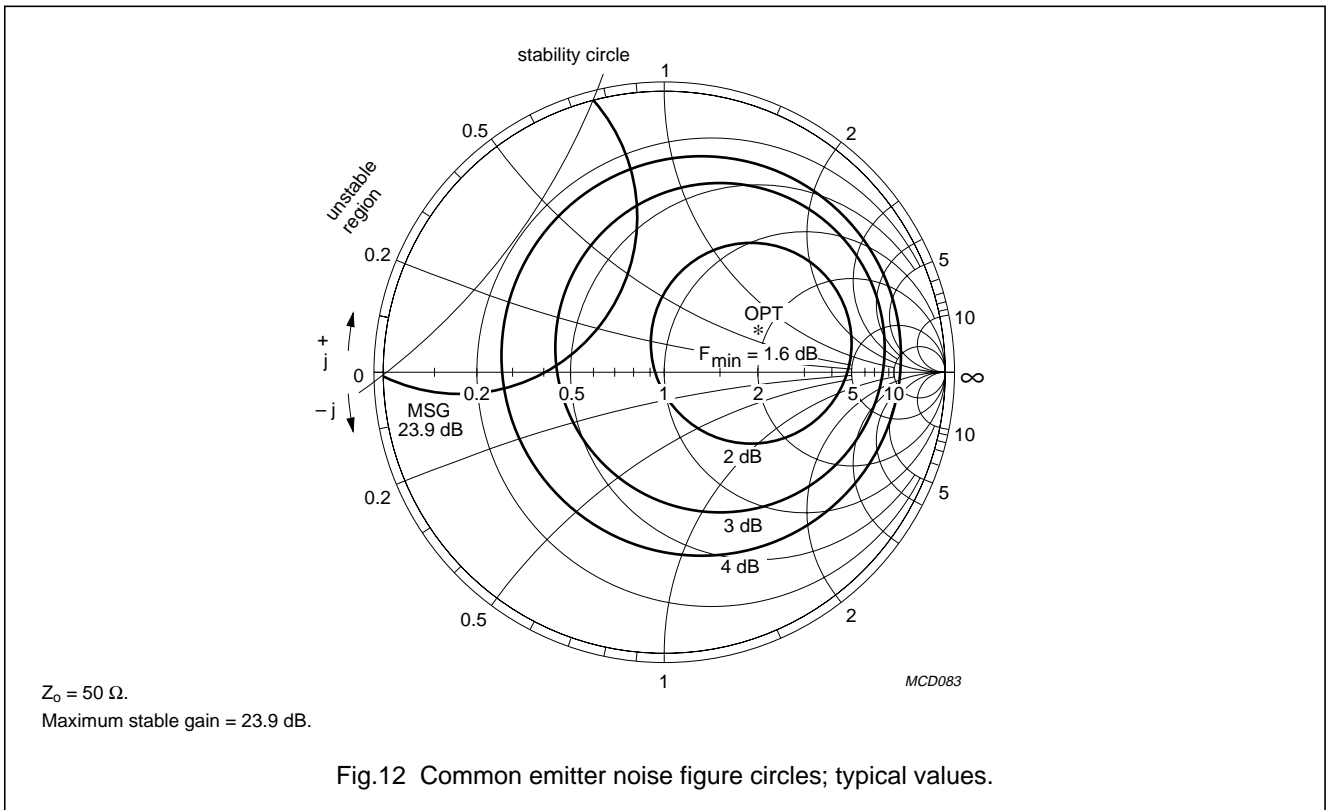
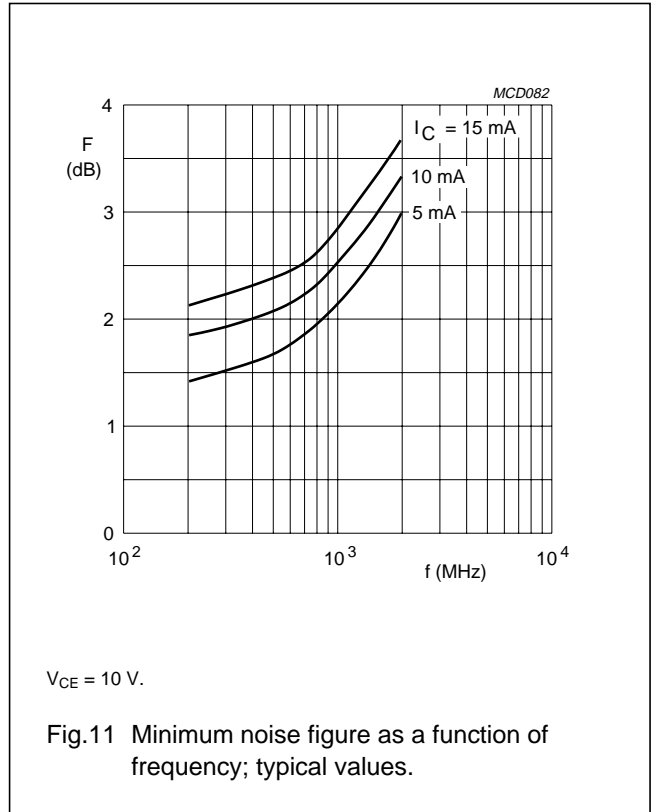
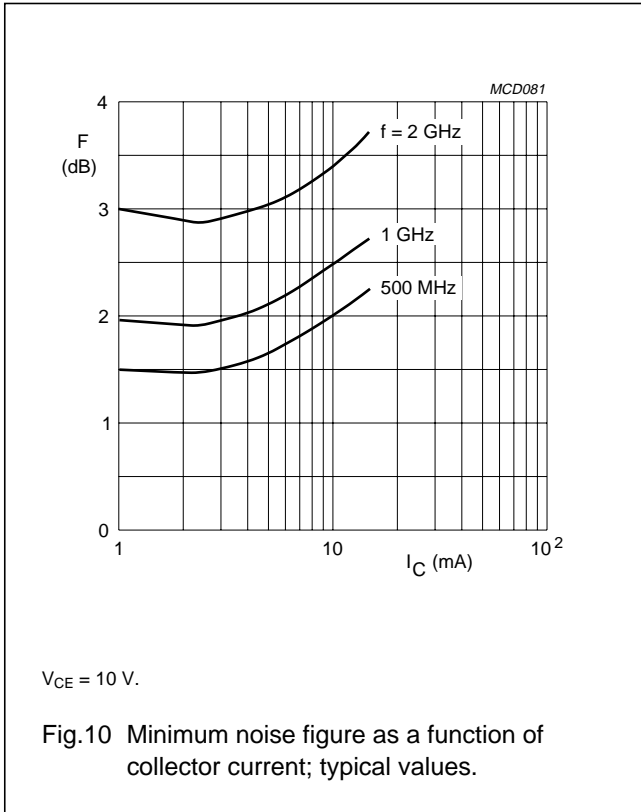
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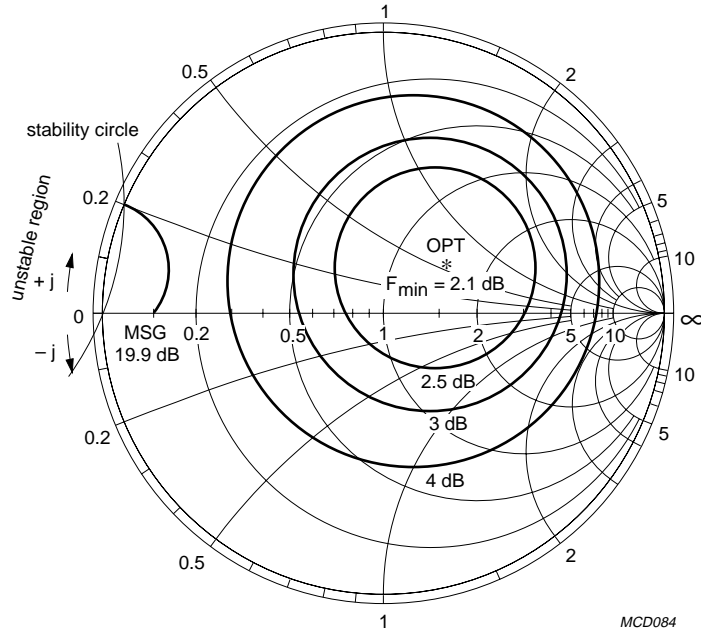
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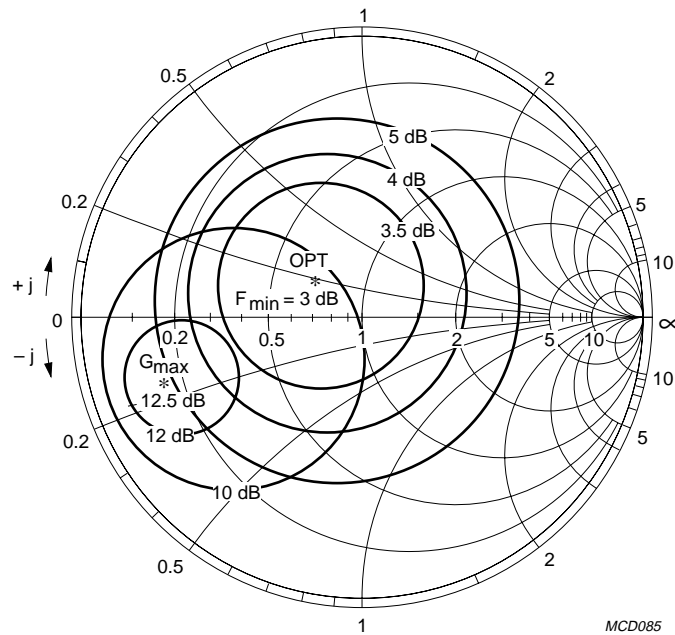
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MCD084

$Z_0 = 50 \Omega$ .  
Maximum stable gain = 19.9 dB.

Fig.13 Common emitter noise figure circles; typical values.



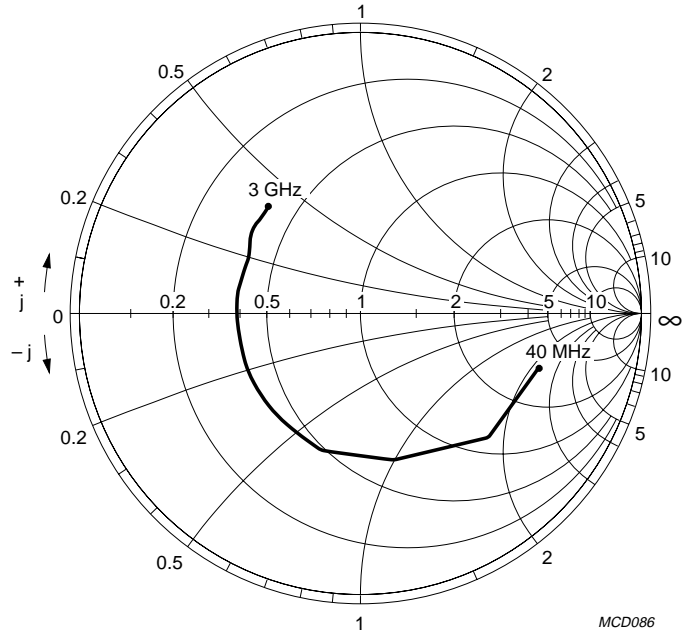
MCD085

$Z_0 = 50 \Omega$ .

Fig.14 Common emitter noise figure circles; typical values.

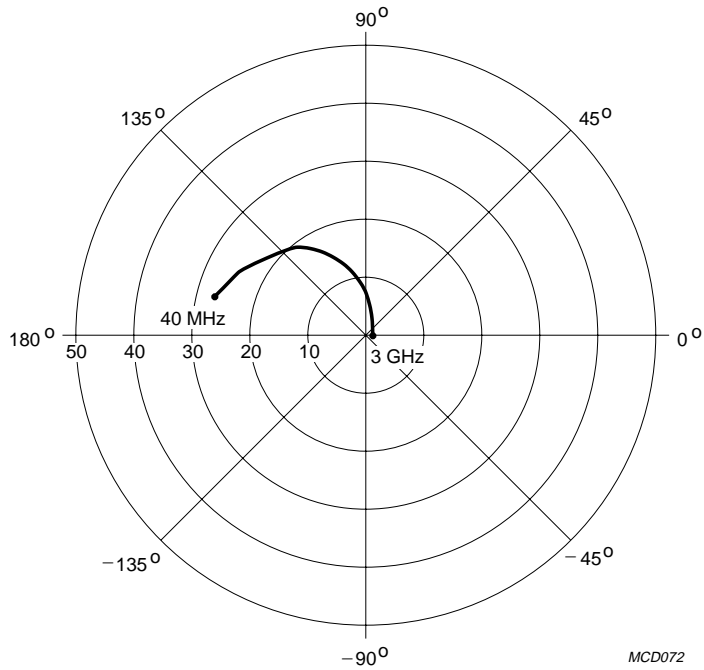
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$V_{CE} = 10\text{ V}; I_C = 15\text{ mA}$ .

Fig.15 Common emitter input reflection coefficient ( $S_{11}$ ); typical values.

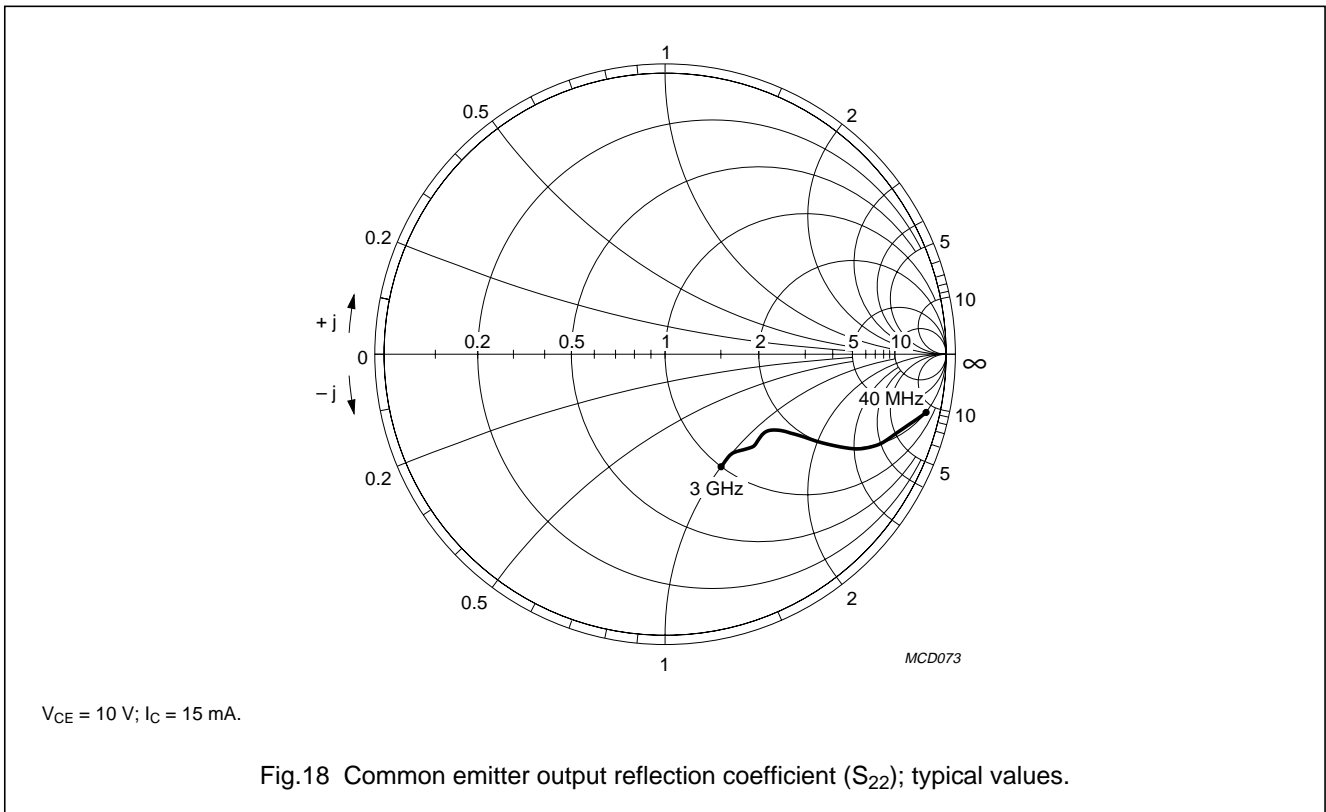
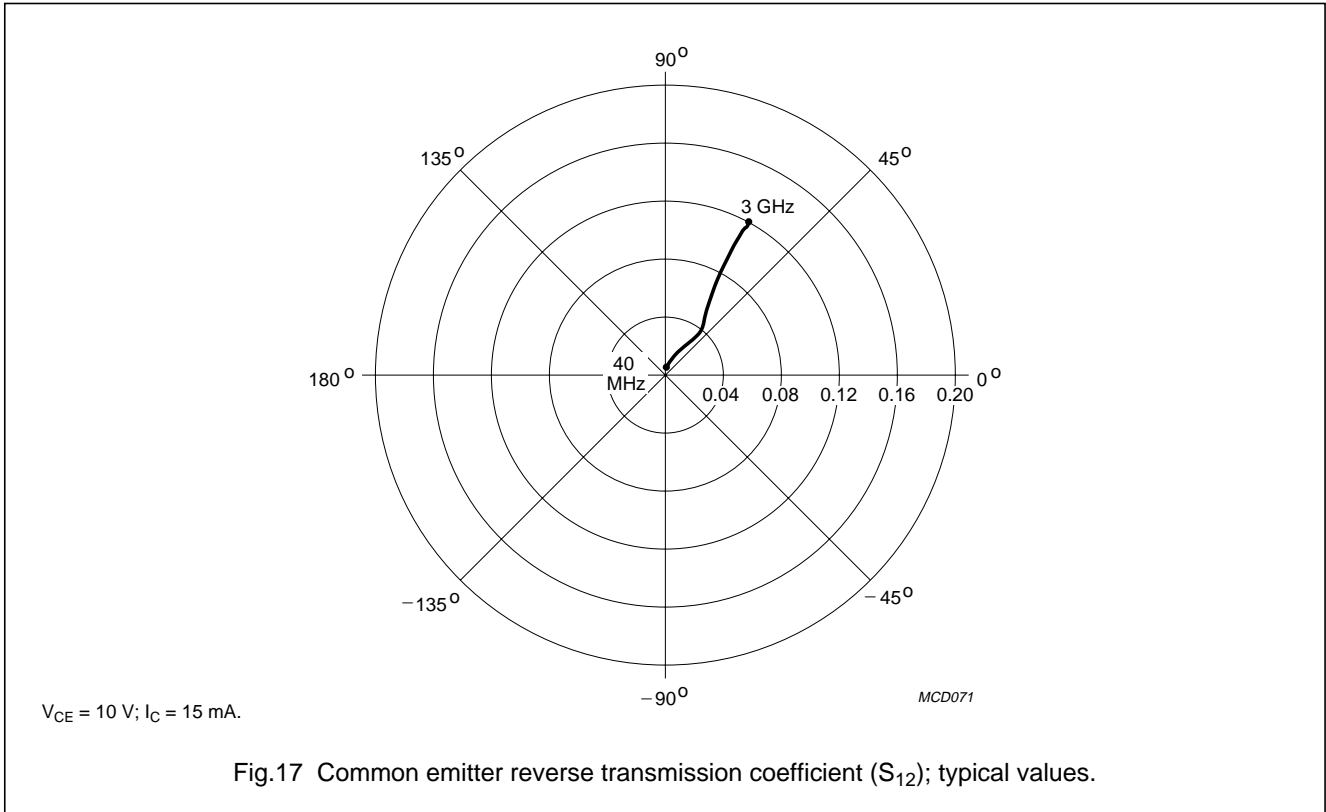


$V_{CE} = 10\text{ V}; I_C = 15\text{ mA}$ .

Fig.16 Common emitter forward transmission coefficient ( $S_{21}$ ); typical values.

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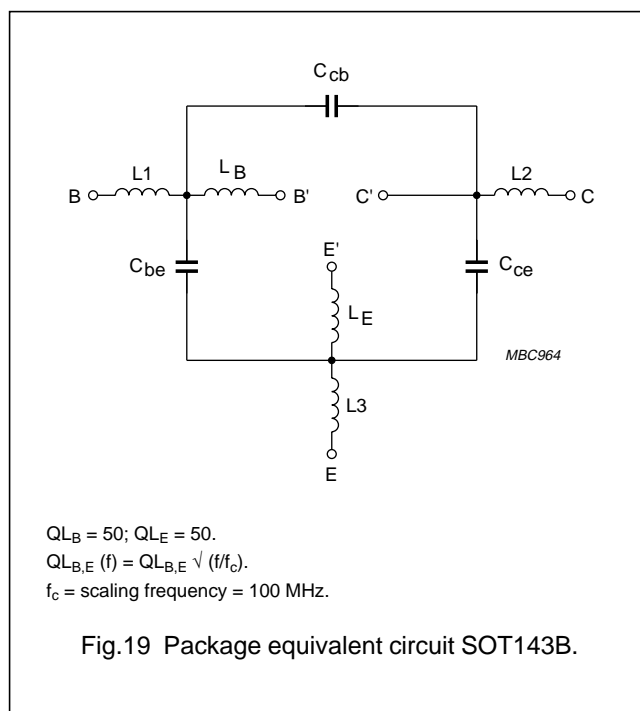
SPICE parameters for BFR90A/X die

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 1            | IS        | 411.8 | aA   |
| 2            | BF        | 102.6 | –    |
| 3            | NF        | 997.2 | m    |
| 4            | VAF       | 62.67 | V    |
| 5            | IKF       | 3.200 | A    |
| 6            | ISE       | 4.010 | fA   |
| 7            | NE        | 1.577 | –    |
| 8            | BR        | 18.10 | –    |
| 9            | NR        | 996.2 | m    |
| 10           | VAR       | 3.369 | V    |
| 11           | IKR       | 1.281 | A    |
| 12           | ISC       | 279.9 | aA   |
| 13           | NC        | 1.075 | –    |
| 14           | RB        | 10.00 | Ω    |
| 15           | IRB       | 1.000 | μA   |
| 16           | RBM       | 10.00 | Ω    |
| 17           | RE        | 1.164 | Ω    |
| 18           | RC        | 2.320 | Ω    |
| 19 (note 1)  | XTB       | 0.000 | –    |
| 20 (note 1)  | EG        | 1.110 | eV   |
| 21 (note 1)  | XTI       | 3.000 | –    |
| 22           | CJE       | 890.5 | fF   |
| 23           | VJE       | 600.0 | mV   |
| 24           | MJE       | 258.5 | m    |
| 25           | TF        | 15.49 | ps   |
| 26           | XTF       | 39.14 | –    |
| 27           | VTF       | 2.152 | V    |
| 28           | ITF       | 213.7 | mA   |
| 29           | PTF       | 0.000 | deg  |
| 30           | CJC       | 546.5 | fF   |
| 31           | VJC       | 380.8 | mV   |
| 32           | MJC       | 202.9 | m    |
| 33           | XCJC      | 150.0 | m    |
| 34           | TR        | 5.618 | ns   |
| 35 (note 1)  | CJS       | 0.000 | F    |

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 36 (note 1)  | VJS       | 750.0 | mV   |
| 37 (note 1)  | MJS       | 0.000 | –    |
| 38           | FC        | 850.0 | m    |

Note

1. These parameters have not been extracted, the default values are shown.



List of components (see Fig.19)

| DESIGNATION     | VALUE | UNIT |
|-----------------|-------|------|
| C <sub>be</sub> | 84    | fF   |
| C <sub>cb</sub> | 17    | fF   |
| C <sub>ce</sub> | 191   | fF   |
| L1              | 0.12  | nH   |
| L2              | 0.21  | nH   |
| L3              | 0.06  | nH   |
| L <sub>B</sub>  | 0.95  | nH   |
| L <sub>E</sub>  | 0.40  | nH   |

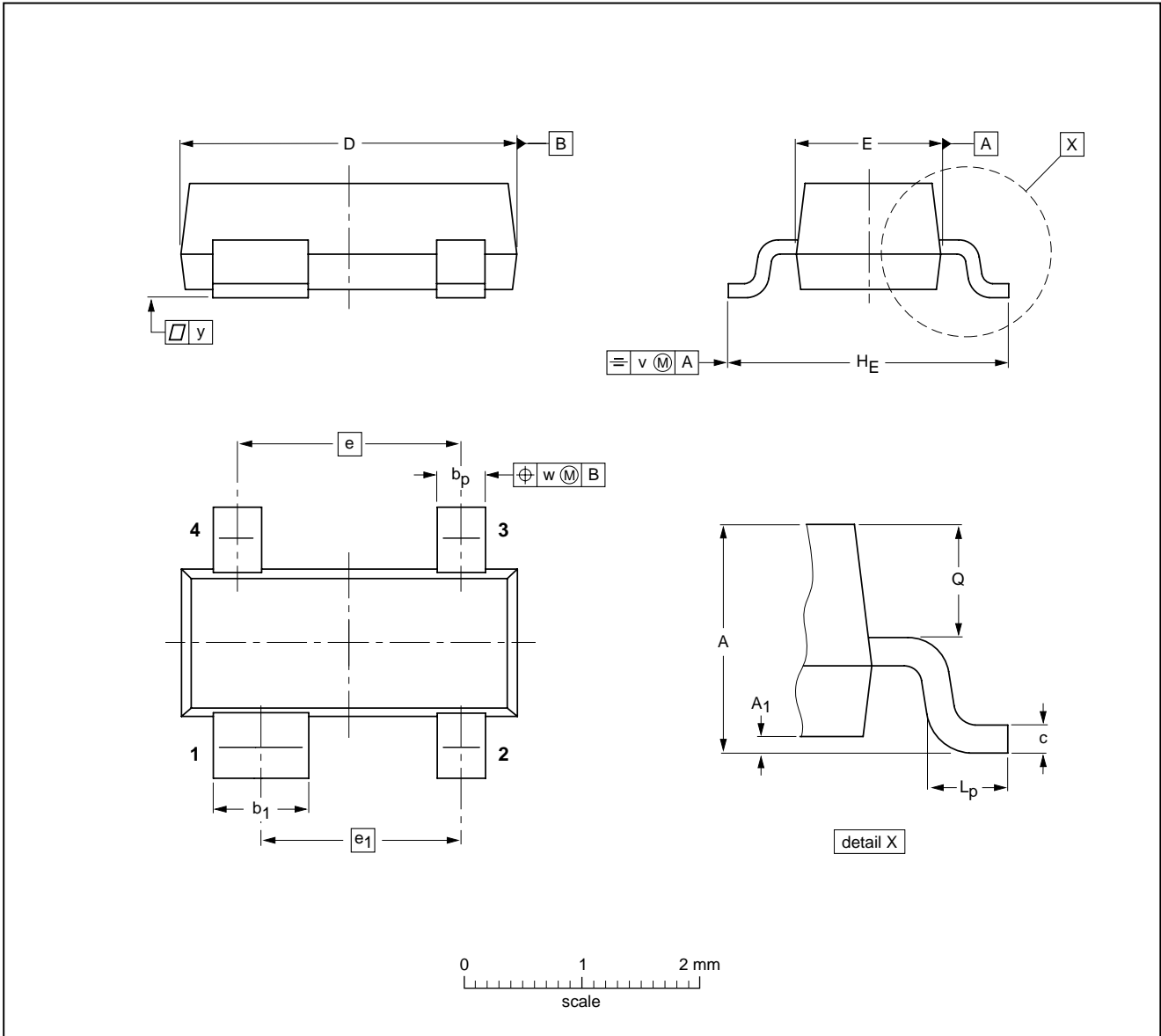
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PACKAGE OUTLINES

Plastic surface mounted package; 4 leads

SOT143B



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max | b <sub>p</sub> | b <sub>1</sub> | c            | D          | E          | e   | e <sub>1</sub> | H <sub>E</sub> | L <sub>p</sub> | Q            | v   | w   | y   |
|------|------------|-----------------------|----------------|----------------|--------------|------------|------------|-----|----------------|----------------|----------------|--------------|-----|-----|-----|
| mm   | 1.1<br>0.9 | 0.1                   | 0.48<br>0.38   | 0.88<br>0.78   | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7            | 2.5<br>2.1     | 0.45<br>0.15   | 0.55<br>0.45 | 0.2 | 0.1 | 0.1 |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |            |
| SOT143B            |            |       |      |  |                        | 97-02-28   |

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| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
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[2] The term 'short data sheet' is explained in section "Definitions".

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## Revision history

### Revision history

| Document ID                   | Release date   | Data sheet status     | Change notice | Supersedes     |
|-------------------------------|--|-----------------------|---------------|----------------|
| BFG92AX_N_6                   | 20080312   | Product data sheet    | -             | BFG92AX_N_5    |
| Modifications:                | • Characteristics Table; DC current gain value changed |                       |               |                |
| BFG92AX_N_5                   | 20071126   | Product data sheet    | -             | BFG92AX_4      |
| BFG92AX_4<br>(9397 750 04344) | 19980923   | Product specification | -             | BFG92SERIES_3  |
| BFG92SERIES_3                 | 19950912   | Product specification | -             | BFG92SERIES_2  |
| BFG92SERIES_2                 | 19921101   | Product specification | -             | BFG92_SERIES_1 |
| BFG92_SERIES_1                | -  | -                     | -             | -              |

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